Exploration of Asynchronous Online Teaching With a Network Analysis of Class Interaction

Rhoda Baggs, Ph.D.
Dept. of Computer Information Systems
Florida Institute of Technology
Melbourne, FL USA 32901
rbaggs@fit.edu

Chan Wei Wu
Dept. of Computer Information Systems
Florida Institute of Technology
Melbourne, FL USA 32901
wu2009@my.fit.edu

Abstract— Constant changes in technology for course delivery, along with constant changes in the technological social landscape, challenge the instructional technologist when it comes to nailing down the appropriate teaching technology for online or distance learning courses. This paper focuses on the ongoing problem of how to best teach online courses in the computer information systems (CIS) field for a graduate master’s program. Although it is generally thought that specific methods should be used to extend traditional electronic communication tools such as email, discussion forums, and live chats, there is no universal agreement as to what those tools should be. The foci of this research are to 1) shed light on current teaching practices, 2) make suggestions for methods which augment traditional email, forums, and chats, 3) to measure email interaction in two CIS core courses, and 4) to glean information based on the email interaction captured. Leaping onto the current flavor of the month online community like Twitter, Facebook, etc. is considered as an addition at the coursesite level, but is probably not a good idea where university policies, standards, and accreditation play a role. Additionally, the collaborative learning that social networks encourage may not be appropriate for all learning disciplines, especially in the fields of computer science and mathematics.

Keywords: Online teaching methods and tools, distance learning, Web 2.0, asynchronous teaching methods, sense of community, social networking, computer information systems education, virtual communities.

I. INTRODUCTION

There have been several examples of studies and experiments which focus on social network analysis [3][5][19]. In [5] Wegerif found that “for the purpose of forming a community and for the purpose of effective collaboration it is important that students have as equal as possible access to the shared conversation.” This author also formulates and discusses a threshold phenomena whereby students go from feeling like “outsiders” to feeling like “insiders”.

When hiring professors and course deliverers/facilitators for online courses oftentimes faculty are asked to teach courses as online courses, that they have traditionally taught in the classroom; under the assumption that methods, tools and approach will not change significantly. However, after managing about a dozen faculty who teach graduate level Computer Information Systems (CIS) courses online over the past six years, there are three primary realizations that stand out: 1) new faculty need a course template to follow that may go beyond traditional learning management systems (LMSs); 2) the current explosion in tools and technology to assist and augment course content make it difficult to obtain, disseminate, and employ new technologies to be used in class, and 3) although program assessment for online courses does match assessment methods for face-to-face classes, evaluating student satisfaction with online courses probably should be done differently. This introduces many questions, some which are listed below.

How much beyond traditional LMS tools can adjunct faculty be expected to use in a typical semester long class?

What methods are most effective when collecting data on students with the goal of measuring social interaction without impinging on their privacy?

What is the best way to get faculty up to speed on effective technology tools which assist in teaching online?

Is academic freedom an issue with mandating online teaching templates and methods?

Online courses typically are managed via a web-based learning management system (LMS) and some examples include Angel, Blackboard, Moodle, and WebCT. Mainly the LMSs are web site based to provide wide area use and ease of use, and offer facilities to exchange email, have discussion forums, hold live chats, and offer virtual office hours. Content is centralized and self managed by faculty, and pieces are typically reusable from semester to semester. Some LMSs also provide gaming facilities, blogging, remote desktop facilities, test taking facilities and drop boxes. If faculty want to provide media such as video or audio, this is usually done separately with links to streaming media. Video may be provided along with tutorials, links for learning resources, Skype, slides, and a wide variety of material to augment the text book for the course.

Currently, academicians have even taken the potential online teaching toolset a tad further, as we struggle to add the social component to the online classroom(s) that are managed. Traditional brick-and-mortar academics and students alike agree that a component often missing from these teaching
environments is a sense of belonging, student stakeholdership, and/or the sense of community that is inherent in face-to-face learning. In the face-to-face classroom experience social interaction is naturally achieved by virtue of the fact that the students are physically already in a community and in a social environment in and out of the classroom. Should we try to chisel this into our course curricula and how should we do it? What types of incentives can be used to encourage student interaction and should we be doing this?

Some of the information and data contained in this paper is based on 6 years experience as program chair for the Master of Science in Computer Information Systems degree program at a SACS accredited private university. This program has been offered online and face-to-face simultaneously during that time. This research and its supporting data and ideas are also based on a recent questionnaire given out to 25 online faculty and is also the culmination of a survey of research of what others are doing in this area. Then finally a free software Excel template called NodeXL [21] is used to measure interaction of students and faculty for two CIS core courses: CIS 5220, Computer Organization and CIS 5100, Data Structures & Programming. The purpose of this research is to ascertain what our online faculty are currently utilizing in terms of methods and tools, what others are using and have found success with, and to measure internal LMS email interaction with a recent offering of a hardware course and a software course. It is a basis for future consequences which may include 1) some guidelines for online faculty to improve the current class template in use with CIS graduate level online classes, 2) the increase of student satisfaction and retention, and 3) the reduction of the disenfranchised or problem student by providing more (and different) communication options with classmates, professors, and other university personnel.

II. WHAT ONLINE COMMUNITIES ARE DOING NOW

A. Questionaire for Faculty

A voluntary anonymous questionnaire was given to a subset of the university’s online faculty and 25 respondents were tallied. As a result it was ascertained that many or most of the faculty rely heavily on email and discussion forums for discussing course topics. About 75% of the faculty who responded also make available their phone numbers as a means of communication with students. All faculty currently use some sort of LMS such as Angel, Blackboard, or WebCT, etc. 84% of respondents said they employed “forum” thread type discussion boards on the class’s subjects. When asked if social networking types of phenomena were used such as Facebook, Myspace, Twitter, etc. roughly half claimed to use such tools and half admitted to not using these tools as part of the classroom. Use of the LMS is a requirement with all faculty who teach CIS graduate courses. Use of a social component or online community web site such as Facebook or Twitter is currently not a requirement in any of the classes.

B. Current Online Student Culture

In general, it has been noted that the students of online classes are far more likely to comment on the teaching methods and tools used in the online course, than in the face-to-face equivalent. Although it may be hard to prove, one current popular theory is that adding a social component to a class may help alleviate student issues and stress for at least a particular subset of the student population. However, before making this leap it is prudent to consider all of the possible side effects that bringing on a social network can cause.

Many educators claim that collaboration among students can prove to be a good strategy for student learning and can give students a pedagogical advantage [2][3][4]. Extending the concept of collaborative projects from brick-and-mortar (BAM) classrooms to the online learning environment has been accomplished by some educators using social networks, online communities, and other forms of electronic communication. However, in the computer information systems field it is not clear if collaborative learning is suitable for courses in programming and hardware (i.e. computer organization).

C. Current Online Faculty Culture

Currently, faculty who are asked to teach online classes are expected to hold chats, utilize teaching tools to augment the experience, use email and forums, and guide their students through a wide variety of communication methods. The creation of video, pod casts, audio, animation, or canned lectures is in some cases being achieved, but has not yet been universally adopted. Simultaneously, text book publishers are seeing the benefit of augmenting text books for online course use and many texts now come with one or more media for instructors and students to use.

In the CIS department some faculty and students have done some original development of online materials to augment some of the core courses. For instance, at

http://es.fit.edu/off-campus/melbourne/cis/cis5100/

is a viewable list of 14 Flash tutorials covering many introductory topics in software design and for use in the “Data Structures and Programming” course. This sort of material is useful but does not qualify as a social component nor does it foster social interaction among students of a class. Another example of a one-on-one tutorial can be found at

http://es.fit.edu/off-campus/melbourne/cis/projects/integer/streaming/

which incorporates a video of a professor teaching material (in particular the representation of INTGGER data) for the Computer Organization class. Visitation and answering the questions at the end is a homework requirement for some classes. Student response of these tutorials is generally positive.

Online educators tend to rely heavily on the learning management system (LMS) that is dealt to them. At F.I.T., several LMSs are in place and used by the faculty. However, the MS/CIS program mandates that all of its faculty use Angel as a minimum for teaching online courses. All BAM MS/CIS instructors use it as well.
Social interaction among students which includes the instructor within the LMS can be achieved via the embedded email, discussion forums, and live chats. Social interaction among CIS students in general outside of the LMS can be achieved a number of ways, including:

- University-wide email
- University sponsored list servers, including:
  - A list server for CIS students on campus
  - A list server for CIS students everywhere, worldwide
  - A list server for FIT staff and students
- This is not an exhaustive list of available list servers for students
- Facebook pages affiliated to F.I.T. (there are many)

As part of this research we try to measure or at least be made aware of student interaction. This research paper will not measure interaction via Florida Tech email but will measure Angel internal (to coursesite) email. The list servers, which have been utilized since the program’s online component was instituted 6 years ago, are ideal for making departmental announcements such as scheduling, advising, booklists, deadlines, meet-n-greet opportunities, and other policy issues. The CIS program administrators routinely post to these list servers and finds them quite valuable. However, even though student interaction is encouraged on these list servers, there is little student-to-student interaction. Facebook interaction among university students and personnel exists but has not been measured as part of this research.

D. Outside Media

Various university personnel (mostly students and faculty) have created several videos and tutorials to be used to augment CIS course material, mainly for core courses in programming, software design, and computer organization. With most universities, ownership of said media is by the university, if university owned resources were used to produce the media and ownership is by the faculty if the faculty member uses his/her own resources. For instance, the aforementioned 2 links in II.C. above contain media that is owned by the university and not the creators of the media. This has caused some faculty to use personal resources to create media and house it for students, thus retaining property rights. This is currently a very hot topic with faculty in online communities because of the extra and often time consuming effort that the faculty may devote to such projects. Additionally, it has become more feasible and affordable than ever for faculty to singlehandedly create media such as video, audio, or animation and to store it off site. Here is one example where it makes sense to use something like an external web page or Facebook page to house such media if the creator wishes to retain property rights.

III. LEARNING MANAGEMENT SYSTEMS

A. LMS Characteristics: Angel

Since most CIS faculty in this study use Angel, the concentration here will be on Angel and its characteristics and functionality. In general, Angel includes the following characteristics and tools for use:

- Web site based
- Embedded email
- Discussion forums
- Live chats
- Virtual office hours
- Games (crossword puzzles)
- Test Taking facilities
- Drop boxes
- Links to media

These tools and mechanisms represent several ways for a faculty member to communicate to a student and in some cases for students to communicate with one another.

Since LMSs are often the lifeblood of the online classroom, much like the BAM physical classroom is historically and traditionally, it is important not to ignore the issues to address when committing to or mandating the use of an LMS for all faculty for all courses in a particular program or curriculum. Some of these issues/questions are listed below.

B. Important Questions Surrounding the Use of LMSs

- Let us define “outside media” as anything that is not the property of the university. What is the best way to represent this outside media when it is used to augment the content of the course? How does intellectual property factor into all of this?
- Are LMSs the best tool for implementing course group projects that need to cross course section boundaries?
- What policies, procedures and protocols need to be defined and documented when it comes to the correct use of LMSs (or other methods) by students and faculty?
- What other tools are recommended to be used outside of the LMS? And, if outside social networks (aka online communities) are to be used to augment delivery and communication within a course or program, then how should these networks be administered and used, specifically?

IV. WHAT IS SOCIAL NETWORKING?

Social networking really has two very distinct meanings within today’s culture. These can be represented well with the two extremes: first social networking can be as simple as 2 people talking, and secondly, social networking can be 100% electronically achieved and measured. Either way the network
can have very small (2) or very large node populations (billions or more). According to [3], "A social network consists of a number of people and their relationships to each other". Social Network Analysis is defined to be "the mapping and measuring of relationships and the flow between the people belonging to the network"[3][18]. In [2], Liccardi, et al., define social networks as "a social structure of nodes that represent individuals (or organizations) and the relationships between them within a certain domain." Within the context of this paper the social networks to be analyzed will consist of two student/instructor populations for 2 courses taught in the Spring 2010 semester. Since we can use a network (or graph) to represent interactions of participants in any group then analysis of this network reflects or reveals interaction. Others use social network analysis to analyze networks in the social sciences, communication studies, economics, political science, etc.[15] These social networks are not necessarily online communities, but represent a model of interactions of a group, given that the information can be accurately gathered and stored. In summary, the type of social network analysis employed for this research paper is based upon student/instructor LMS internal email for two specific courses.

When used to model student-student or student-faculty interaction within a course in any university setting, please note that this may require Institutional Research Board approval (in the U.S. at least). Clearly if the networks accurately reflect student interactions in a particular course LMS, then the networks, through the usual network searching and interconnectivity algorithms can be used to show expertise, student activity and participation, and strength of connectivity to the faculty member of the course.

V. MEASURING SOCIAL INTERACTION USING NODEXL

A. What is NodeXL and what can it show?

NodeXL is a template for Excel 2007 which allows users to analyze relationships from data[21]. In [20], the authors use NodeXL as a social networking analysis software tool and represent participant interaction and connectedness within a group of online students with the intent of ultimately measuring "mastery of course outcomes". NodeXL provides simple graphs and digraphs for networks in general. Here it is used to give a pictorial view of a measure of interaction and connectedness among students and faculty for 2 specific CIS LMS Angel coursesites by modeling internal email.

See the NodeXL graphs below in the next section. Within each graph there is one special node for the instructor and every other node has a unique ID representing an (anonymous) student. Interesting and useful information can then be gleaned from this data including items in the list below.

Results from NodeXL graphs provide information about interaction between nodes (where a node is either a student or instructor). Some specific results are:

1) edge number (or weight) – shows “popularity” or degree of interaction between 2 nodes
2) isolated nodes – shows the existence of isolated students who had no interaction via internal Angel email
3) number of emails among students
4) number of emails between instructor and students
5) number of times an instructor sent an email to “all” (students)
6) number of times a student sent an email to “all” (students)

Data was gathered from two CIS courses offered online every semester: CIS 5100 Data Structures and Programming and CIS 5220 Computer Organization. These two courses are required core courses and one represents a software programming course (in Java) and the other is a basic hardware, computer architecture course. Data in the form of ordered pairs representing all LMS internal email for each course is represented in an undirected graph with the following characteristics:

- Each node has a unique ID and represents either a student or the instructor of the class
- Weights on each arc represent the number of emails sent between nodes.
- Data analysis was divided up into student-to-student data, student-and-instructor data, and anybody-to-anybody (in the class) data.

See the figures below. The analysis follows.

B. NodeXL Graphs

In Fig. 1., we see a pictorial view of student and instructor interaction in the computer organization course.

In Fig. 2., we see a pictorial view of student and student interaction in the computer organization course.

In Fig. 3., we see a pictorial view of student and instructor interaction in the programming (in Java) course.

In Fig. 4., we see a pictorial view of student and student interaction in the programming (in Java) course.

In Fig. 5., we see a pictorial view of student and instructor and student/student interaction in the programming (in Java) course.

![NodeXL Graphs](image)

Figure 1. Computer Org. All LMS email interaction between instructor and student(s)
C. Analysis of the NodeXL Graphs

The comp. org. class had 13 students and the programming class had 17 students that finished the course, but the data analyzed includes anybody who dropped the class in the first 2
weeks. Both classes each lost 2 students in the first 2 weeks (not an unusual early attrition rate for CIS classes). Therefore, there are 15 nodes in the graphs for the comp. org. class and there are 19 nodes in the programming class graphs and this poses some analysis problems that are addressed below. The programming professor also used outside (of the LMS) email to communicate with his students. The comp. org. professor tried to use LMS email exclusively with his students. The weights on the edges in each graph represent number of emails between the two nodes

The following bulleted list represents an analysis of the NodeXL graphs above.

- In Fig. 1, the average number of emails between instructor and student was overall 21, but if you excluded the two edges with 1 email, the average is 24 which is probably more accurate. Given a 15 week semester, then this is 1-2 emails per week with the instructor. Note that this is comp. org. data.
- In Fig. 3, the average number of emails between instructor and student was overall 11, but if you excluded the two edges with 1 (or less) email, the average is 23 which is probably more accurate. Given a 15 week semester, then this is 1-2 emails per week with the instructor. Note that this is the programming course data.
- An isolated node in a graph implies no interaction between the student and instructor (or student to student). In Fig. 1, there are no isolated nodes and the 2 nodes with an edge of 1 email are probably the two students who dropped, so the average shows a relatively sufficient number of emails per week per student.
- With the programming class data the 8 nodes with 0 or 1 email is surprising, but this may be because the professor also uses outside (LMS) email. In this same graph (Fig. 3) there is one student who had 57 emails which was excessive when compared to others in the class. It is also interesting to note that this same student was the only student who sent email to other students in the class (see Fig. 4).
- Likewise in the comp. org. class, only 1 student sent email to the other students in the class using the LMS email. (see Fig. 2).
- Fig. 5 was a graph that was included in this paper to show the dynamic of a graph with everybody (both student-to-student and student-and-instructor data) in one graph.
- None of this research takes into account university server student email outside of the LMS. Collection of that data is much more problematic since the domain that governs that data is a completely different domain in the university hierarchy.
- Directed graphs were also produced which showed who initiated the email. However, the weights were not as readable and this is why the undirected graphs were chosen for this paper.

VI. CONCLUSIONS

A. Conclusions From Data

In both classes, the student to instructor emails averaged 1-2 per week. In both classes, there was little student-to-student email interaction, so if the students are interacting it is either by university wide email (which is not visible to the instructor or anybody else) or by some other means. No deduction can be made that no interaction is going on since there are so many other means of communicating electronically.

The software class instructor also used university wide email extensively and the hardware class instructor tried to use Angel email only to simplify things. It is interesting that this did not cause an increase in email in Angel with the hardware course participants. Either type of email is available via a web browser.

The meaning of isolated nodes is diminished since data includes students who dropped the course. Next collection of data for future research will attempt to exclude that data.

B. The three P’s: Policies, Procedures, and Protocols

It has been discussed amongst the faculty, and one use of online communities like Facebook would be to augment the student experience in a particular online course that crosses multiple section boundaries. This can be described as the use of any sort of web page, discussion forum, or online community to allow collaboration of students from different sections of the same course. Although this idea seemed to have some inherent benefits, since different students from different sections could bring different knowledge (on the same subject), it became immediately apparent that the buy-in of university personnel would need to go beyond the faculty and the program chair of the program. For instance, a virtual computing lab for all CIS students or the building of any sort of laboratory in general has not been explored. Except for the laboratory, the majority of BAM course teaching of multiple sections do not necessitate teaching methods or provide resources that cross course section boundaries. For instance, if an online community forum were to be used such as Facebook, it is not clear where the collaboration might stop; i.e. the line into cheating and plagiarism might be crossed or inadvertently encouraged. In some cases, encouraging or perpetrating an online community may be deemed a precedent that might require new protocol and policy. Unfortunately, this is a common pitfall when doing anything experimental with actual students in an actual program, and it may prove to be difficult to get IRB and administrative approval.

Currently, F.I.T. has no policies when it comes to faculty using social networks (not run by the university) for classroom use. This follows the traditional view of academic freedom and so it is anticipated that this will continue to be the policy. However, there are policies requiring faculty to use particular LMSs, and this does not seem to be avoidable when managing online faculty, sometimes from afar.

C. Teaching Techniques

F.I.T. CIS faculty are using a multitude of tools and methods to augment the traditional use and content of the
learning management system. Specific conclusions here focus on what sort of teaching template to recommend for use for teaching online classes.

Specific recommendations to faculty include:

• A balance must be reached so that there is sufficient interaction between faculty and student. Although little interaction works with some students, too much interaction often indicates a larger problem. However it is important not to deluge the students with too much work or interaction, although “keeping the student busy” is a natural inclination with the teaching of this curriculum.

• LMSs are here to stay and students are pretty comfortable with how they are used in our program, for the most part.

• It has been noted that “Problem students” or students having issues with the course are likely to complain about teaching methods and the LMS or the instructor’s use of the LMS.

• Students are far more likely to voice opinions on teaching methods in online courses over BAM courses and the reasons for this are unclear. However, this is a driving force for including or increasing social interaction. Many believe that stakeholdership or feeling like the “insider” has benefits for keeping the potentially problem students engaged in the course and its topics.

D. Network Analysis Conclusions

• Social network analysis of student-student and/or student-faculty interactions may reveal some interesting results if the IRB allows it to be measured. Isolated nodes, in-degree and out-degree of nodes, and network node connectivity can show connections, but the strength (or validity) of those connections may also need to be measured and this may take extra computational measures and tools such as NodeXL.

• Data collection for future work for input to NodeXL probably should include outside (LMS) email and should exclude anybody who doesn’t finish the course. Another option would be to segregate that data.

• Because of privacy issues and IRB issues, it is almost impossible or very difficult to make correlations between student satisfaction and number of emails, or to correlate student grade with instructor interaction. Getting approval to obtain such data in a timely fashion has been one of the biggest challenges (and surprises) with this research effort.

• One must be careful when encouraging “collaboration”, especially when it comes to program writing and coding. The issue of cheating must be addressed and boundaries should be set up. Plus, it is not clear how collaboration may be used pedagogically in the virtual classroom when teaching software programming and other core courses such as computer organization.

There is much work to be done and although there is a lot of activity in the area of social networking, online communities, and the augmentation of traditional teaching methods and techniques, nailing down a formal teaching template is still a work in progress. Recommendations for additions to the traditional LMS based template will be made formally to all faculty, but will not be required for use at this time. However, this will not stop the continued effort to create media for specific topics to be covered in particular courses, as part of the so-called augmentation learning resource suite that is being built for the students and faculty of this program.

REFERENCES


